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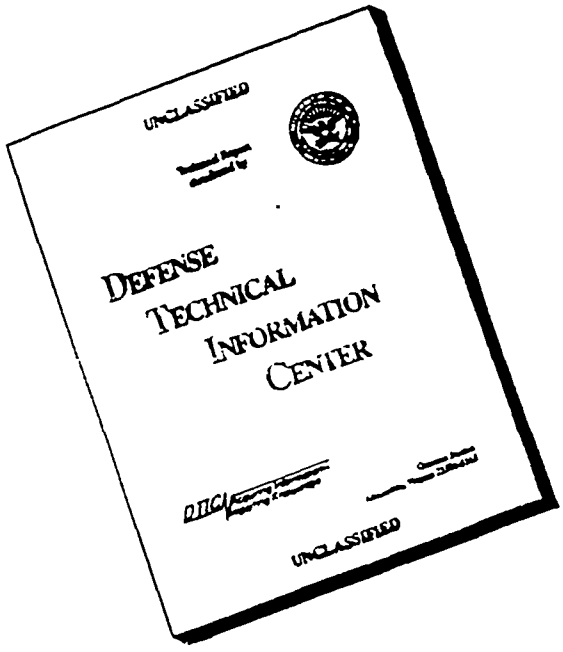

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PERT COORDINATING GROUP,

TECHNICAL PAPER #1

Common Problems Associated With Implementation and Operation of the PERT Cost System,

Special Projects Office
BuWeps, Department of Navy
Washington, DC 20332

PERT COORDINATING GROUP:

Office of the Secretary of Defense
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P R E F A C E

This document represents the first in a series of Technical Papers to be prepared and published under the auspices of the PERT Coordinating Group. They are not at anytime to serve in place of or attempt to up-date the PERT Guides; they do not represent official policy or procedure.

The PERT Coordinating Group Technical Papers are intended to respond to some of the questions and problems that appear to bother people the most and to translate these problems into opportunities. In addition they serve to make available special material or experiences likely to be helpful to a wide selection of persons in Industry and in the Government.

The PERT Coordinating Group endorsement indicates recognition that the material may fulfill this objective. A special distribution list is maintained by the PERT Orientation and Training Center for this purpose.

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PREFACE

Since initial efforts toward implementation of the PERT COST System began over two years ago, considerable experience has been gained both in the implementation and the operation of the system. The PERT Orientation and Training Center is publishing this pamphlet, a description of problems encountered in system implementation and operation at contractor locations compiled by the Special Projects Office, Department of the Navy and indorsed by the PERT Coordinating Group, to assist others in both industry and government who face similar problems.

This document is not a guide to implementation, and no directive authority is implied. Rather, as it identifies some common problems associated with system installation and operation, it should be used as a supplement to existing system and implementation guides. The contents may be reproduced in whole or in part provided appropriate credit is given.

SECTION I. KEY FEATURES OF THE PERT COST SYSTEM

1. What is PERT COST?

PERT COST is a planning and control technique for development and construction projects. This technique is designed to assist project managers in estimating, budgeting, and controlling the schedule and costs required to achieve technical performance objectives. The basic elements of PERT COST include:

- an orderly product definition in the form of a work breakdown structure.
- a list of the work packages[1] required to complete the project objectives. (The work package is the basic unit for assigning schedule and cost responsibility to first-level supervision and, as such, is the basic foundation for the PERT COST System.)
- an account code structure which establishes number codes to identify work packages and summary items on the work breakdown structure. The account code structure permits the summation of schedule and cost information by product item, responsible organization unit, manpower skill, and time periods.
- PERT networks which portray the activities and events necessary to achieve the project objectives. The activities are related to specific work packages.

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[1] A work package is a specific job to be accomplished; i.e., a design, a drawing, a task, a piece of hardware, or a service which is within the responsibility of one operating unit in an organization and which contributes to one item on the work breakdown structure.

- timely and meaningful reports for contractor project and functional managers and for the customer.

- corporate policy and procedures defining system objectives and operating instructions.

2. What will PERT COST do?

PERT COST will:

- display a plan for accomplishing the project, and identify the degree to which the various parts of a project have been planned.

- portray the interrelationships between the tasks to be performed.

- relate the estimated and actual costs to specific work packages rather than to types of effort with calendar date beginning and ending points.

- provide estimates-to-complete work packages.

- relate schedule advances or schedule slippages to specific work packages, and enable more accurate appraisal of the cost impact of a schedule change.

- permit the timely appraisal of the cost and schedule impact of proposed engineering changes.

3. What benefits can be expected from PERT COST?

PERT COST provides:

- a clearer definition of the work to be performed and the cost associated with

specific segments of the project.

- a framework for the development of accurate time and cost estimates to complete the project.
- earlier identification of potential cost overruns and underruns.
- earlier identification of potential schedule advances or slippages.
- improved management knowledge of current and predicted project status.

SECTION II. PERT COST IMPLEMENTATION PROBLEMS

This section highlights the problems associated with the introduction and initial application of the system. Any one of these problems could hamper or even defeat an effective implementation.

PROBLEM 1: Lack of Management Support and Participation

PROBLEM 2: Failure to Organize for PERT COST Implementation

PROBLEM 3: Faulty Interpretation of PERT COST Guidance Documents

PROBLEM 4: Failure to Integrate Fully Existing Systems With PERT COST

PROBLEM 5: Narrow Scope and Slow Pace of PERT COST Implementation

PROBLEM 6: Incompatibility of Contract Items With Program Elements

PROBLEM 1: LACK OF MANAGEMENT SUPPORT AND PARTICIPATION

Without active line and staff management support, PERT COST will become a mechanical reporting exercise operated by a cell of specialists. Consequently, it will be an expensive burden rather than a useful management tool.

Symptoms That a Problem Exists:

- PERT COST information not used in management meetings.
- PERT COST implemented and operated by an internal organization which has little or no project decision-making authority and which receives only superficial support and inputs from operating organizations.
- Internal system planning, updating, and reporting cycles not well established and specific responsibilities not assigned.
- Unwieldy, excessively detailed reports.
- Failure to present feedback information to operating managers who provide basic input data or to prepare a plan for distributing reports to those responsible for making program decisions.
- No provision for formal or on-the-job training at all management levels in the effective use of the system and how it relates to individual responsibilities.

Recommended Action by Contractors:

- Issue corporate policy regarding intent to employ PERT COST as an internal management tool.

- Require a detailed procedural handbook,

- Define the organizational responsibilities of the technical and administrative managers.

- Conduct training and indoctrination programs on a continuing basis to assure that not only current personnel understand the system, but that new personnel are acquainted with it.

- Employ effective management displays to avoid overwhelming key managers with excessive detail.

- Use management reports to identify problem areas and to communicate with other levels of management within the system framework.

Recommended Action by Customer:

- Provide feedback and critiques of PERT COST reports to the contractor so that he knows these reports are being used and are not just being filed.

- Request periodic briefings regarding PERT COST implementation progress and benefits which have been realized from the system.

- Discuss problems indicated in the reports with contractor managers responsible for making program decisions.

- Define clearly the volume and depth of information needed to make customer level decisions, so that the contractor does not think that the customer is

trying to "manage his business for him."

- Require contractors to provide summary reports and analyses, and call for detailed supporting data only when problems are indicated and this data is likely to clarify action to be taken.

PROBLEM 2. FAILURE TO ORGANIZE FOR PERT COST IMPLEMENTATION

When the initial implementation effort is not well organized with the objective of serving as a project manager's tool, the system will be ineffective.

Symptoms That a Problem Exists:

- No clear assignment of the responsibility and authority for implementation.
- Absence of a working team, task force, or organization for implementation.
- Lack of a specific implementation plan.
- All planning and control functions not included in or available to the primary implementing organization.

  Implementing organization reporting below the project manager level.

Recommended Action by Contractor:

- Establish an implementation task team whose leader reports to the project manager or to an equivalent level.
- Team develops an implementation plan which is approved and monitored by management.
- Establish clear team objectives to implement PERT COST as both a reporting and internal management tool within a specified time span.

Recommended Action by Customer:

- Require the contractor to identify one person with prime responsibility for PERT COST implementation.

- Designate a customer representative to assist the contractor in integrating customer directives and intentions.

PROBLEM 3. FAULTY INTERPRETATION OF PERT COST GUIDANCE DOCUMENTS

Many guidance documents describing PERT COST concepts must be interpreted by contractors for effective implementation. However, too strict an interpretation can slow the pace of implementation and create unnecessary burdens; too loose an interpretation can prevent the system from producing the desired results.

Symptoms That a Problem Exists

- No internal contractor procedures issued because "all the problems are not solved" (too strict interpretation) or "no need for procedures" (too loose).
- Extensive internal staff studies on detailed operating problems (too strict).
- No implementation organization or working team (too loose).
- No briefing or orientation sessions for the contractor management (too loose).
- Briefing sessions stressing the system mechanics rather than the objectives and benefits (too strict).

Recommended Action by Contractor:

- Develop a procedures document describing how PERT COST operates in the particular contractor environment.
- Emphasize the operational capability and benefits rather than the mechanical perfection.

- Institute interim operating procedures when major changes may be required to achieve an optimum solution, particularly when major changes may consume considerable time before being effected.

Recommended Action by Customer:

- Approve the contractor procedure document for compliance with customer requirements.

- Designate a customer representative to assist the contractor in interpreting documents.

- Publish implementation guidance documents identifying the customer policy in approving contractor interpretation.

- Issue instructions to the contractor identifying what elements of the system operation the customer specifies (e.g., reports) and what is left to contractor discretion (e.g., resource code identification).

PROBLEM 4: FAILURE TO INTEGRATE FULLY EXISTING SYSTEMS WITH PERT COST

Even after a contractor is committed to installing PERT COST, there is a tendency to implement and operate the system in parallel with existing systems. Consequently, PERT COST becomes expensive and has marginal value as a management tool. While it is highly desirable to integrate PERT COST with the existing systems, the integration can be ineffective if the existing systems are weak and unreliable; their shortcomings will affect the timeliness and validity of the PERT COST output.

Symptoms That a Problem Exists:

- Continued maintenance and use of redundant systems which PERT COST was intended to replace.
- Generation of PERT COST reports by a specialist group, while operating managers receive other reports and data which cannot be related to PERT COST information.
- Multiplicity of data processing mechanisms, either manual or computer, or both.
- Excessive estimates for the cost of operating PERT COST following implementation.

Recommended Action by Contractor:

- Emphasize that top management will not allow redundant systems and procedures.
- Study all data collection systems and reports and identify opportunities to integrate, consolidate, and/or eliminate them.

- Train the operating organizations to utilize data from PERT COST reports.

Recommended Action by Customer:

- Have the contractor indicate how internal data systems relate to PERT COST reports.
- Consider PERT COST a normal management tool, not a direct cost line item.
- Recognize that PERT COST is not an end in itself but is a management tool which embraces the traditional disciplines of planning, scheduling, cost accounting, work assignment, and responsibility budgeting.
- Audit the system operation and the relation of PERT COST reports to internal reports.

PROBLEM 5: NARROW SCOPE AND SLOW PACE OF PERT COST IMPLEMENTATION

When PERT COST is applied to only a small portion of a project and at too slow a pace, management cannot realize full benefits and will lose interest in the system.

Symptoms That a Problem Exists:

- Initial application to a small, isolated part of a project or to a separate, small contract.
- Subcontractor effort not included as an integral part of the prime contractor's implementation.
- No formal plan for extending the scope of the application.
- Extensive staff studies on detailed operating problems.
- No firm schedules for producing PERT COST output reports.

Recommended Action by Contractor:

- Initiate a formal plan for extending the initial application to all appropriate project areas.
- Assign specific responsibilities, authorities, and schedules for solutions to operating problems.
- Institute interim measures in areas where final solutions require major changes.

- Prescribe a schedule for producing, delivering, and acting on PERT COST output reports.

Recommended Action by Customer:

- Require the application of PERT COST to all appropriate project areas.
- Review and approve the contractor's schedule for full application.
- Establish and enforce a contractor/ customer reporting cycle.

PROBLEM 6: INCOMPATIBILITY OF CONTRACT ITEMS WITH PROGRAM ELEMENTS

When the contract items are not compatible with the program elements as described in the work breakdown structure, the contractor must duplicate his controls and reports to monitor performance against both frameworks. This duplication increases operating costs and decreases motivation to use PERT COST effectively, since contractual obligation is to manage by contract item.

Symptoms That a Problem Exists:

- Contract items represent level of effort or functional tasks.
- Contract written on an annual basis.
- Contract in existence before PERT COST implementation started.

Recommended Action by Contractor:

- Prepare the proposal and negotiate the contract items based on the work breakdown structure.
- Use PERT COST in the Request for Proposal stage.

Recommended Action by Customer:

- Issue the Request for Proposal on the work breakdown framework.
- Negotiate the contract items consistent with the work breakdown structure elements.
- Negotiate total program (or major program phase) contracts.

SECTION III. PERT COST OPERATION PROBLEMS

This section includes the significant problems related to the continuing operation of PERT COST on a program. If the issues which face the contractor and customer during implementation are recognized and positive action is taken, the chance of operational problems arising is minimized.

PROBLEM 1: Incomplete and Loosely Defined Work Breakdown Structure

PROBLEM 2: Inadequate Work Package Definition

PROBLEM 3: Inappropriate Level of Detail for Project Control

PROBLEM 4: Inadequate Networking

PROBLEM 5: Invalid Time Estimating and Scheduling

PROBLEM 6: Invalid Cost Estimating and Budgeting

PROBLEM 7: Failure to Provide Adequate Updating Procedures

PROBLEM 8: Inappropriate Means of Processing Data

PROBLEM 9: Failure to Guide Subcontractor PERT COST Efforts Adequately

PROBLEM 1. INCOMPLETE AND LOOSELY DEFINED WORK BREAKDOWN STRUCTURE

The work breakdown structure is the basic element in the PERT COST System for portraying project objectives and integrating time and cost. Unless both the customer and the contractor participate diligently in its development, many other implementation tasks, such as networking and cost estimating, cannot be accomplished effectively.

Symptoms That a Problem Exists:

- No top-level work breakdown structure prepared by the customer.
- Identification of functionally oriented effort rather than project end-item definition.
- Vague definition of work packages and the manner in which they relate to the contractor's internal organization and responsibilities.
- No clear procedure for summarizing basic data internally generated by the contractor.
- Omission of services, documentation, and other end-item classifications, thereby failing to account for total program costs.
- Lack of alignment between the project work breakdown and the contract structures.

Recommended Action by Contractor:

- Seek customer definition of the project

in terms of a project work breakdown structure.

- Assure that the proposal team developing the structure includes both technical and management representatives.

- Require that key project and funcational managers review and approve the structure.

Recommended Action by Customer:

- Provide the contractor with a top-level work breakdown structure.

- Provide written specifications for the work breakdown structuring.

- Publish a project work breakdown showing relationship of all participating agencies and contractors.

- Assure that contracting officers are knowledgeable about PERT COST and that the contract work statements are aligned with the work breakdown structure.

PROBLEM 2. INADEQUATE WORK PACKAGE DEFINITION

Unless work packages are clearly defined in specific increments of accomplishment (not level of effort) and in "manageable" size and duration, summarized data will be of marginal value to management and work performance at the operating levels cannot be measured.

Symptoms That a Problem Exists:

- Vague task descriptions of the work to be performed.
- Difficulty in identifying a precise completion event or milestone for each total work package.
- No clear single responsibility for the work described in a work package.
- No clear distinction between the specific performance work packages and those which are level of effort, such as sustaining engineering.
- Network activities and detailed schedules not identified with the work packages.
- Majority of the work packages extending for the life of a contract or for more than six months.
- Arbitrary peaks and valleys in the cost projection.
- Lack of procedures describing how operating supervisors can make time and cost estimates so that the schedule requirements and cost estimates are complementary.

- High percentage of labor and material costs allocated to the work packages from large funding pools, rather than estimated individually for each work package.

Recommended Action by Contractor:

- Require the project and operating organizations to define work in terms of specific accomplishments.
- Ensure that all responsible and performing organizations involved in a work package agree to the scope, timing, and performance objectives.
- Prepare written procedures for work package definition, which includes a description of how schedule and cost integration is to be achieved.
- Establish a criteria for the duration and dollar magnitude of work packages, and review those work packages which deviate appreciably.
- Isolate the level of effort work packages, and determine if they can be more precisely related to performance objectives.
- Assign responsibility for each work package performance to one organization.

Recommended Action by Customer:

- Define and review the work packages during contract negotiation and execution.
- Require precise work package definition in the contractor proposals.

- Establish a criteria for the duration and dollar magnitude of the work packages.

- Align the contract tasks consistant with the project work breakdown structure.

PROBLEM 3. INAPPROPRIATE LEVEL OF DETAIL FOR PROJECT CONTROL

The statement that "PERT COST requires too much detail" is heard frequently and reflects a wide-spread misconception about the PERT COST System. The primary cause of this attitude is that contractors tend to view PERT COST as a Government reporting device, rather than as an internal management tool. Experience indicates that most existing contractor management systems contain a substantial volume of detailed data, but that this data is not developed within a common planning and control framework, nor is it integrated within one system. PERT COST is simply a device for integrating and for summarizing schedule and cost data. It requires the same amount of detail required by existing contractor systems if the contractor systems are maintained at an appropriate level of detail for adequate project planning and control.

When selecting a level of detail, the project manager can and must exercise his judgment and should consider familiarity with the work to be performed and the time available for planning. Too much detail will make the system application unwieldy, slow response time, and reduce data validity. Too little detail will prevent the project manager from tracing problems to the responsible working level supervisor, forestall identification of schedule and cost underruns or overruns, and create a system which is a reporting facade.

Symptoms That a Problem Exists:

- Output reports not available in time to allow managers to take effective corrective action (too much detail).
- Excessive work package cost accounts, requiring the operating personnel to allocate their time among several charge numbers daily or weekly (too much detail).

- Wide variations in overruns and underruns at the basic charge number level, with a tendency for these variances to "wash" at the summary levels (too much detail).

- Networks which contain activities representing long spans of effort and few interdependencies (too little detail).

- Large number and variety of reporting and control mechanisms feeding into PERT COST, but which cannot be related adequately to summarized PERT COST data (too little detail).

- Many work packages extending over six months, with each representing a large percentage of the direct project dollars (too little detail).

Recommended Action by Contractor:

- Examine thoroughly the volume, quality, and level of the data generated by the current systems.

- Establish policy and procedures for using PERT COST as an internal management tool to be integrated with the existing data systems.

- Project manager establish criteria for selecting the appropriate level of detail.

- Vary the level of detail in different parts of the project, depending on the magnitude, criticality, and complexity of the project area.

Recommended Action by Customer:

- Examine the levels of detail and the quality of source data being generated to support the summary reports.
- Set due dates for the output reports, and follow up if reports are late.
- Arrive at acceptable levels of back-up detail and reporting during contract negotiation.
- Establish reporting levels geared to the magnitude and complexity of different parts of the project.

PROBLEM 4. INADEQUATE NETWORKING

Networks are a key feature of the PERT COST System. They are a device for portraying a project plan to assure that all work is included in the plan and that the interrelations among project tasks are identified and displayed. Without a sound network plan, showing activities, events, and task relationships, the validity of time and of cost estimates is doubtful. Furthermore, the manager's ability to obtain project control data and to make time and cost trade-off decisions is substantially reduced.

Symptoms That a Problem Exists:

- Networks unrelated to the elements of the project work breakdown structure.
- Fragmented networks for various parts of the project and no overall network plan to tie the various supporting networks together.
- A majority of network activities which indicate the time intervals between events rather than define the work to be performed.
- Networks which contain activities representing long spans of effort and few planned or required work interdependencies.
- No clear responsibility for performing the work described by an activity or for reporting the completion of specific events.
- No clear relationship between the detailed schedules and networks.

- Difficulty in identifying critical paths for an entire project.

- Project personnel responsible for performing the work have limited knowledge of what information is contained in the networks and how it is to be used.

- No evidence that the networks are used to establish schedules or to support cost estimates.

- Networks maintained by a cell of specialists with little or no input or feedback from the operating personnel.

- Networks terminating at the fiscal year end instead of at the major project accomplishments.

Recommended Action by Contractor:

- Use the work breakdown structure as a basis for network development.

- Assign personnel responsible for network planning and for status control directly to the project manager whom they will serve.

- Assure that the networking function is well integrated with other project planning and control functions, including cost control, budgeting, and technical requirements.

- Establish clear policies and procedures regarding the use of networks internally, as well as for customer reporting.

- Project manager review the detailed networks periodically to ensure that they accurately reflect the program plan and the current status.

Recommended Action by Customer:

- Prepare a program summary network consistent with the overall work breakdown structure, and require contractors to generate supporting networks.

- Review the contractor's planning and control functions and related procedures to ensure that the network responsibility and authority among staff and line personnel is delineated and is understood.

- Publish written specifications and descriptions to clearly establish the network requirements.

- Use the networks and the data derived from them as a key communication device with contractors.

- Require networks which adequately portray the program plan to be submitted with proposals.

PROBLEM 5. INVALID TIME ESTIMATING AND SCHEDULING

The validity of time estimates depends upon the experience and concientious efforts of the estimator. Without clear work definition through the preparation of a project work breakdown structure, identification of work packages, and generation of network plans, the estimator can not effectively apply his experience. Consequently, the value of network time estimates and the ability to assess customer-directed dates and to establish detailed schedules are limited. Subsequently generated control information also is of marginal use to the project manager.

Symptoms That a Problem Exists:

- Time estimating performed by personnel not thoroughly familiar with, or responsible for, the work to be performed.
- No relation between the internal detailed schedules and the time data generated from the networks.
- Negotiation of the major directed dates without the benefit of a network evaluation to determine the reasonableness of these dates.
- Detailed schedules established before the generation of networks and time estimates (i.e., forcing the networks to fit predetermined detailed schedules).
- Where three time estimates are required, a tendency for the majority of estimates to represent a normal distribution (e.g., 2-4-6).

Recommended Action by Contractors:

- Project manager assure that the work packages and associated network plans clearly define work to be performed before time estimating begins.
- Assign the primary responsibility for time estimating to the personnel who will be accountable for work performance.
- Review the potential schedule problems with the customer before the directed dates are fixed.
- Evaluate the customer-directed date plans through network analysis.
- Require thorough network analysis before establishing the internal, detailed schedules.

Recommended Action by Customer:

- Use network analytical techniques as one basis for establishing the directed date requirements.
- Require three time estimates for only those projects or portions of a project that represent high uncertainty.
- Review the contractor networks and time estimates periodically to ensure that the detailed and master schedule dates are realistic.

PROBLEM 6. INVALID COST ESTIMATING AND BUDGETING

When work packages represent long-term levels of effort, cost estimates and budgets are frequently loosely related to the specific work to be performed. By counting organization personnel and multiplying the total by an activity elapsed time, a contractor can estimate and budget man-hours and cost to satisfy PERT COST requirement. This cost data, however, does not reflect the actual man-hours required to perform a specific work package. Instead, it represents the payroll required in each department for performing a type of effort over the precalculated elapsed time. As long as this practice continues, PERT COST or any other planning and control technique will be ineffective as a tool for generating basic source data to measure cost versus progress in achieving the project objectives.

Symptoms That a Problem Exists:

- Parallel operation of PERT COST and an internal company budgeting and cost control system.
- Difficulty in correlating the internal budgetary controls with the budget elements of the work breakdown structure.
- Excessive "budget pools," representing a significant percentage of the contract value, from which allocations to project accounts are made.
- No provisions for additions or deletions to the budget when scope of work changes for a work package.
- No procedure for transferring the budget when work is transferred from one organization to another within a company.

- Frequent budget adjustments to eliminate overruns or underruns without changes in work responsibility of work scope thereby reducing the value of the budget as a performance target.

- Failure to budget the material and other direct costs at the work package level in cases where these costs can be associated with a work package.

- No overhead budgeting systems. (Most overhead budgets are based on a negotiated contract percentage of direct labor, without consideration of the overhead and administrative work content and manpower requirements.)

- Cost estimates which do not terminate at specific completion events for the work packages.

- Cost estimates which terminate at the contract completion dates with no provision for total project estimating. (This problem is particularly apparent when projects extending over several years are contracted for on a fiscal year basis.)

- Term or level of effort contract for the work to be performed.

- Long duration work packages with cost estimates which reflect the sustained manpower levels.

- No provision to time-phase manpower, material, and other direct cost estimates.

- Failure to consider the types of manpower skills in estimating and controlling direct labor.

- Composite estimating rates which are calculated for a large group of personnel whose skills and salary levels vary appreciably.

Recommended Action by Contractor:

Many of the foregoing "symptoms" are indications that any cost estimating, budgeting, and control system is weak. These symptoms are not only found in PERT COST installations, but more frequently are brought forcibly to management attention when PERT COST is first introduced in an organization. Consequently, if a contractor finds a number of these symptoms in his PERT COST application, a thorough review and strengthening of the organization's cost control system are necessary.

Recommended Action by Customer:

- Assure that the procurement, project management, and technical personnel are thoroughly familiar with the elements of a good cost estimating, budgeting, and control system, as well as with the features of PERT COST.

- Issue the contracts for life of the project (or major project phases), stressing that the estimating and budgeting be performed by the contractor.

- Align the contract tasks with the elements of the work breakdown structure to minimize duplication of budgetary systems.

- Require that the contractor provide cost estimates for proposed project changes and, when changes are approved, that budgetary action be taken.

- Require that the contractor maintain budgets for the project elements without change for at least three months, unless the change is justified by a modification in responsibility or scope of work.

- Review the effectiveness of overhead budget and control systems and the validity of composite estimating rates.

- Require that the contractor minimize the use of allocated pool charges; that is, large budget pools from which allocations to project accounts are made.

- Assure that the cost estimating and budget data reported to the customer are the same as the data used internally.

PROBLEM 7. FAILURE TO PROVIDE ADEQUATE UPDATING PROCEDURES

In the planning and control of development programs, the ability to handle frequent, and often significant, changes must be considered. The impact on program objectives of a change in technical approach, a funding reduction, or a schedule slippage must be identified, evaluated, and presented to management for action. Without formal updating procedures which allow rapid introduction of change information and comparison with the basic plan, any project planning and control system will falter. Management will lose confidence in the data provided by the system, and progress of the project will be impaired.

Symptoms That a Problem Exists:

- Late output reports providing historical information already known by the project management and with marginal predictive value.
- No formal updating procedures specifically indicating when and how new data should be introduced, the data processing cycle, and the specific output report target dates.
- No provision in the procedures for considering changes to the basic data and the relationship of the changes to the updating cycle (e.g., material cost, labor, schedule, and subcontractor changes).

Recommended Action by Contractor:

- Prepare formal updating procedures which indicate the data cutoff dates, processing cycles, and report delivery dates, and follow up to ensure that the dates are met.

- Review all schedule and cost source documents related to PERT COST work packages to ensure that they include direction to the first line supervisor for providing current change information with minimum administrative effort. (If the requirements at this level are too cumbersome, the line supervisor will not take time to perform an effective updating.)

- Assure that the PERT COST reports which are summarized through successive levels of management are delivered promptly to each level. (Frequently, reports will be held for excessively long periods by lower level supervisors before the data is submitted to higher levels. (This is particularly true when the reports contain adverse information).

- Assure that the supervisors understand that cost estimates to complete should reflect work remaining and not merely record manpower to be retained.

Recommended Action by Customer:

- Establish customer level updating procedures to encompass the submission of revised information from all associated contractors and, particularly, from agencies involved in the project.

- Require that the contractors prepare, review, and approve the procedures.

- Establish report delivery dates, and follow up when the reports are late.

PROBLEM 8. INAPPROPRIATE MEANS OF PROCESSING DATA

Customer and contractor PERT COST data processing needs vary from project to project, depending upon the magnitude of the project, the existing data processing capabilities, and the availability of suitable computer programs. A thorough study of data processing needs must be made for each PERT COST installation to ensure that basic data can be gathered, processed, and reported rapidly and with high validity. The costs of various data processing approaches must be examined in relation to the information requirements. In some cases, it may be more efficient to adapt an available PERT COST computer program, while in other cases, particularly where a project is small or a contractor does not have sophisticated computer equipment, a manual or semi-automated data processing approach may be preferable. While the data processing method selected is important in terms of the timeliness and the validity of information reported, it must be considered secondary to the effective use of PERT COST as a management tool.

Symptoms That a Problem Exists:

- A high percentage of manual data manipulation on large and complex projects where automated techniques would assure more timely and valid information.
- Attempts by contractors who have a relatively small part of a project to use computer techniques when manual methods could generate reports from basic data faster and less expensively.
- Adjustment of source data by each higher level of management so that the summarized data bears little relationship to the initial source data.

- Substantially different data processing methods employed by a contractor for reporting to various customers on different projects.

- No provision by the contractor to integrate a selected PERT COST computer program with other internal data processing routines through tape-to-tape conversions or replacement of internal processing mechanisms. (Without such provision, a cumbersome manual transfer of data from internal output tapes to PERT COST input forms is required, thereby reducing the validity and the timeliness of the PERT COST reports.)

- Efforts initiated to develop new PERT COST computer programs without any evidence that available programs have been thoroughly examined for their applicability.

- The misconception that "inadequate data processing" is responsible for all shortcomings in the PERT COST operation.

Recommended Action by Contractor:

- Review the entire internal data processing capabilities and current or potential customer PERT COST requirements with the objective of integrating processing mechanisms and employing a uniform PERT COST program to serve all customers and projects.

- Study the available PERT COST programs to determine their applicability to internal needs before starting new programming or modifying available programs.

- Prepare cost analyses of various PERT COST data processing approaches in relation to

the timeliness and validity of the output reports.

Recommended Action by Customer:

- Assure that a group of customer personnel is familiar with the details of available PERT COST programs in order to provide guidance to the contractors.
- Coordinate the data processing activities and requirements with other customer agencies to minimize the burden on the contractor from meeting nonuniform requirements.
- Require the contractor to examine the entire data processing problem thoroughly before approving a specific approach.

PROBLEM 9. FAILURE TO GUIDE SUBCONTRACTOR PERT COST EFFORTS ADEQUATELY

Subcontracting frequently accounts for a major portion of the value of a development contract. It is imperative that the prime contractor devote adequate attention to the subcontracted portion of his effort, since the contractor's overall project performance can be impaired by the performance of his subcontractors. Consequently, the prime contractor must be assured that at least the major subcontractors are effectively employing PERT COST.

Symptoms That a Problem Exists:

- No customer criteria to guide a prime contractor in the application of PERT COST to the subcontracted effort.
- No clearly written direction to the subcontractors specifying PERT COST requirements and the minimum acceptable levels of detail.
- No provisions in the prime contractor's policies, procedures, and PERT COST information flow diagrams for the inclusion of subcontractor PERT COST data.
- Task statements negotiated between prime and subcontractors not aligned with the project work breakdown structure.
- Strict requirements levied upon subcontractors, with ineffective PERT COST application by the prime contractor on his in-house effort, thereby setting a poor example.
- Late reports to the customer from the prime contractor caused by delays in subcontractor reports.

Recommended Action by Contractor:

Throughout this document, customer action has been recommended to overcome specific problems. In his association with subcontractors, the prime contractor assumes the role of the customer. Consequently, customer-recommended actions for the problems discussed previously will have some direct application to the prime contractor-subcontractor situation. Other recommendations include:

- Project managers assure that their personnel responsible for the PERT COST operation devote sufficient attention to guiding subcontractor efforts, particularly where subcontractor efforts are significant in terms of project cost and schedule performance.

- Provide written direction to the subcontractors, covering the PERT COST requirements.

- Assure that the internal PERT COST policies and procedures allow for subcontractor performance.

- Align the task statements and the work breakdown structure elements in Requests for Proposal and in subsequent negotiation of contracts.

- Impose subcontractor PERT COST requirements which are consistent with those followed by the prime contractor.

Recommended Action by Customer:

- Establish criteria for prime contractors which can be used to assure a consistent and orderly application of PERT COST to the subcontractor. (This is particularly important when one subcontractor may also serve as a prime on another project for the same government customer.)

- Periodically review the subcontractor PERT COST efforts with the prime contractors to assure that a sound substructure exists to support summarized PERT COST reports.